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Medication errors: the importance of safe dispensing

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1. Although rates of dispensing errors are generally low, further improvements in pharmacy distribution systems are still important because pharmacies dispense such high volumes of medications that even a low error rate can translate into a large number of errors.
2. From the perspective of pharmacy organization and quality assurance, pharmacists should intensify their checking of prescriptions, in order to reduce prescription errors, and should implement strategies to communicate adequately with patients, in order to prevent administration errors. More and better studies are still needed in these areas.
3. More research is also required into: dispensing errors in out-patient health-care settings, such as community pharmacies in the USA and Europe; dispensing errors in hospitals and out-patient health-care settings in middle- and low-income countries; and the underlying causes of dispensing errors.

Six main types of medication error can occur in the chain of pharmacological and pharmaceutical patient care: prescribing faults, prescription errors, transcription errors, dispensing errors, administration errors, and 'across settings' errors [1]. In this article we focus on dispensing errors.

Definition of a dispensing error

A dispensing error is a discrepancy between a prescription and the medicine that the pharmacy delivers to the patient or distributes to the ward on the basis of this prescription, including the dispensing of a medicine with inferior pharmaceutical or informational quality [1–6].

Categories of dispensing error

Table 1 shows the categories of dispensing errors [1, 2, 3, 6, 7]. If dispensing errors are considered from the perspective that the quality of all pharmacy care activities should be assured by the pharmacist, this list can be extended by the addition of three other categories: failure to detect and correct a prescribing error before dispensing; failure to detect a manufacturing error before dispensing; and failure to provide adequate patient counselling in order to prevent administration errors. These categories arise in other segments of the pharmaceutical patient care chain, but they are nevertheless important when one strives for a full assessment of the pharmacy's performance [8, 9].

Recent studies of dispensing errors

We searched Pubmed on-line using the keywords 'dispensing errors' and related search terms. We also searched manually for related articles in the reference lists of the studies we retrieved and selected. We used only studies that were published in English after 2003.

Nature and frequency of dispensing errors

Table 2 shows the rates of dispensing errors and different subtypes of dispensing errors [2–4, 6, 7, 10–16, Dutch Association of Hospital Pharmacists (NVZA): unpublished data]. The rates of dispensing errors were 0–45%. The highest rates of dispensing errors were in studies in which a researcher observed the dispensing process or checked and compared the dispensed medicines against the relevant prescriptions.

Some studies used a self-reporting system to count the number of dispensing errors. These studies did not produce any error rates, because the total number of dispensed medicines was unknown, owing to the use of a reporting system that only counted the number of dispensing errors without measuring a denominator [12, 13].

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Table 1
Categories of dispensing errors

Dispensing medicine for the wrong patient (or for the wrong ward)
Dispensing the wrong medicine
Dispensing the wrong drug strength
Dispensing at the wrong time
Dispensing the wrong quantity
Dispensing the wrong dosage form
Dispensing an expired or almost expired medicine
Omission (i.e. failure to dispense)
Dispensing a medicine of inferior quality (pharmaceutical companies)
Dispensing an incorrectly compounded medicine (compounding in pharmacy)
Dispensing with the wrong information on the label
Incorrect patient name
Incorrect drug name
Incorrect drug strength
Incorrect instruction (including incorrect dosage)
Incorrect drug quantity
Incorrect dosage form
Incorrect expiry date
Omission of additional warning(s)
Incorrect pharmacy address
Other labelling errors
Dispensing with the wrong verbal information to the patient or representative

Underlying causes of dispensing errors

Causes of dispensing errors can be traced by root-cause analysis or by eliciting explanations by practising pharmacists by means of a survey. Root-cause analysis comes closer to reality, because a survey measures only the perceptions and opinions of pharmacists. An example of the former type was a study in a UK hospital in which the researchers used semistructured interviews of pharmacy staff about self-reported dispensing errors [2]. In all, 106 error-producing conditions were mentioned in the interviews. The most common causes mentioned were: being busy (21%), being short-staffed (12%), being subject to time constraints (11%), fatigue of healthcare providers (11%), interruptions during dispensing (9.4%), and look-alike/sound-alike medicines (8.5%).

In a Danish study a research team analysed self-reports of community pharmacies to identify the causes of dispensing errors [17]. The research team identified four causes: poor, often unreadable, handwriting; 'traps' (look-alike and sound-alike medications); lack of effective controls; and lack of concentration caused by interruptions.

In a Finnish study a survey questionnaire was used to elicit pharmacists' perceptions and opinions [18]. There were five main categories of potential causes. The first was related to organization (37% of all potential causes given). The other categories were: individual professionals (30%), prescriptions (17%), drugs (10%), and problems with customers (4%). Examples of the last were talkative customers, conversations with customers, customers with many prescriptions, and customers in a hurry.

Two studies have investigated the potential causes of failure to detect and prevent drug–drug interaction problems during dispensing. In the first study the researchers calculated the dispensing ratios for 11 undesirable drug–drug interactions in 256 Dutch community pharmacies; only one of these was significantly related to determinants – the type of medication surveillance system and whether the pharmacy was part of a healthcare centre [19]. The second study was performed in the USA and evaluated the relations between handling 25 potential drug–drug interactions and the operational characteristics of community pharmacies; the risk of dispensing drugs with potential drug–drug interactions was significantly related to pharmacist workload, overall pharmacy workload, and automated telephone systems for prescription orders [20].

Strategies for improvement

Over the years, pharmacies have introduced several methods and strategies to reduce dispensing errors, depending on the different working phases of the pharmacies in the medication process and the development of information technologies [21–25].

We have found only four studies of the effects of these strategies. In the first, the rate of dispensing errors in a US hospital fell from 0.19 to 0.07% by the use of a bar-code system; in a cost–benefit analysis the break-even point for return on investment was during the first quarter of the fourth year [5]. In another hospital study the use of two different dispensing processes using a bar-code system was examined: a carousel fill process, which dispensed compact and nonrefrigeration-requiring forms of commonly used medications into semiautomated medication cabinets; and a 2-day fill process, in which less commonly used medications were stocked manually on shelves and retrieved by hand during the filling step [23]. The carousel fill process reduced the rate of dispensing errors from 0.25 to 0.018% and the second process reduced it from 0.71 to 0.026%.

In a third study a hospital implemented an automated pharmacy carousel system, consisting of bar-coded medication bins, a bar-code scanner, a label printer, and software that allowed the carousel system to interface with the hospital's pharmacy information system [24]. The researchers investigated the rates of dispensing errors and incorrectly filled orders of three dispensing processes, but did not perform statistical analyses. The first process dispensed the first doses for new patient-specific medication orders, which were not readily available from automated dispensing cabinets on patient care units. The missing prescription requests were faxed to the pharmacy and the orders were in a similar manner. Once filled, medication orders were verified by pharmacists before transport. In this process the rate of incorrectly filled orders increased from 2.1 to 2.3%. The rate of dispensing errors increased from 0.5 to 1.2%.

Table 2

Results of studies of dispensing errors

Ref	Setting*	Perspective†	Data collection‡	Categories of dispensing errors	Outcome§	Dispensing error rate (%)	Near-miss dispensing error rate (%)	Top three dispensing errors (%)
2	H	CP	HP	Wrong medication; wrong drug strength; wrong dosage form; wrong quantity; omission; wrong expiry date of medication with quality deviation; wrong information on label; other errors	IO	30/194 584 (0.02)	104/4849 (2.1)	Wrong information on label (46) Omission (19) Wrong drug strength (12)
3	MP	CP	R	Wrong medication; wrong drug strength; wrong dosage form; wrong quantity; wrong information on label; wrong instruction; wrong expiration date; omission	Not studied	16/21 252 (0.08)	Not studied	Wrong information on label (88) Entry wrong quantity in system (6.3) Omission (6.3)
4	H	QP	R	Wrong quantity; wrong drug strength; wrong medication; wrong dosage form; wrong information on label; order entry; wrong expiration date; omission; reconstitution; other errors	CO	1059/140 755 (0.8)	4016/140755 (2.9)	Wrong quantity (59) Wrong drug strength (11) Wrong medication (11)
6	CP	CP	HP	No detailed information; all incidents that were detected during the dispensing process	Not studied	50/125 395 (0.04)	280/125395 (0.22)	Wrong medication (34) Wrong information on label (33) Wrong quantity (17)
7	CP	CP	HP	No detailed information	Not studied	39/51 357 (0.08)	247/51357 (0.48)	Wrong drug strength (23) Wrong medication (19) Wrong quantity (18)
10	H	CP	HP	Wrong medication; wrong dose; wrong patient; other errors	CO	82/NS.	Not studied	Wrong medication (38) Wrong patient (29) Wrong dose (26)
11	CP	QP	HP	Medication selection; dose; communication; prescription; frequency; documentation; patient information; drug monitoring; quantity; device; insufficient information	CO	13/NS	Not studied	No detailed information
12	H	QP	R	Omission; wrong dose; wrong quantity; wrong medication; wrong dosage form; wrong information on label; medication with quality deviation; medication prescribed without concentration, quantity, etc.	Not studied	719/2143 (34)	Not studied	Omission (57) Medication prescribed without concentration, quantity, etc. (13) Wrong dose (13)
13	H	CP	R	Wrong medication; wrong dose; wrong dosage form; wrong quantity; omission; wrong expiration date of medication with quality deviation; other errors; wrong information on label	Not studied	295/655 (45)	Not studied	Wrong quantity (70) Omission (14) Wrong information on label (11)
14	H	CP	HP	Unauthorized medication error; wrong dosage form; wrong dose; omission; wrong time; wrong expiration date of medication with quality deviation	CO	24/7249 (0.3)	155/7249 (2.1)	Wrong dose (32) Omission (30) Wrong time (21)
15	H*	CP	R	An indicated medication was not given (omission); a non-indicated chemotherapeutic drug was administered (wrong medication); the duration of treatment was different (wrong quantity); a >10% difference between indicated and administered dose of any medication (administration error)	Not studied	0/172 (0)	Not studied	No dispensing errors detected
16	CP	CP	HP	No detailed information	CO	203/146 6043 (0.01)	234/958313 (0.02)	No detailed information
17	H	CP	HP	Medication prescribed without concentration, quantity, etc.; prescription errors; administration errors; transcription errors; omission; wrong patient; wrong medication; wrong dosage form; wrong dose; wrong time; compounding errors; across settings errors	CO	915/NS	Not studied	Wrong medication (32) Wrong dose (27) Omission (22)

*CO, community pharmacy; H, hospital; MP, mail pharmacy. †CP, chain of pharmaceutical patient care; QP, quality of all pharmacy care activities. ‡HP, healthcare provider; R, researcher. §CO, clinical outcome; IO, improvements organization.

The second dispensing process was an automated dispensing cabinet fill. The rate of incorrectly filled orders fell from 1.6 to 0.6%. In a repeat measurement the rate fell further to 0.4%. The rate of dispensing errors fell from 0.4 to 0.2% and in the last measurement to 0.3%. The third process was an interdepartmental request fill. In this process the medication orders came from clinics affiliated to the hospital, such as ophthalmology, pain, neurology, and pathology and the cancer centre. No dispensing errors were found in 123 clinic orders (6006 doses) before implementation of the automated pharmacy carousel system. One dispensing error involving a quantity discrepancy was identified out of 85 clinic orders (3505 doses) after installation of the automated pharmacy carousel system. For this process, only dispensing errors were recorded, because interdepartmental requests were filled sporadically throughout the day.

The last study involved the implementation of a computerized drug–drug interaction alerting system in community pharmacies and physicians' offices [22]. The rates of prescriptions with potential interactions were measured in three periods. In the first period about 40% of pharmacies but no physicians' practices implemented the system; in the second period the system was online in 90% of pharmacies and in about 40% of physicians' practices; and in the third period 95% of pharmacies and approximately 90% of physicians' practices used the system. The dispensing of prescriptions with serious interactions by pharmacists was reduced in the second and third periods compared with the first period (21% and 68%, respectively).

Discussion

Most studies have investigated dispensing errors in hospitals in the USA or Europe, from the perspective of the chain of pharmaceutical patient care (i.e. excluding prescribing errors and administration errors). There has been less research on community pharmacies or mail-order pharmacies. The rates of dispensing errors were low to very low. Nevertheless, it is still necessary to pay close attention to dispensing errors, because nowadays pharmacies dispense such high volumes of medications that even a low error rate can translate into a large number of errors [4].

Two independent Brazilian studies have shown much higher rates of dispensing errors. Both research groups correctly concluded that the rates of dispensing errors were high compared with other studies, and they suggested that a possible cause was the absence of verification by the pharmacist [12, 13]. Ten years ago studies in the USA and Europe reported similar high rates of dispensing errors. In one study the rate of dispensing error was 24%; no reasons were given for this [26].

It was difficult to compare reported rates of dispensing errors directly across studies, owing to differences in study design. Researchers have used different operational definitions of dispensing errors and also different denominators (such as total numbers of prescriptions, numbers of dispensed doses, or numbers of prescribed medications). In order to make more direct comparisons between the studies, we recalculated some of the rates of dispensing errors. Nevertheless, the studies are heterogeneous.

Most studies have investigated dispensing errors from the perspective of the integral chain of pharmaceutical patient care, but not all categories of dispensing errors have been investigated. Our Pubmed search may not have been sufficiently specific to retrieve all such studies and was also limited in time and to English-language papers. We found two studies that classified dispensing certain undesirable drug–drug interactions as dispensing errors, but no studies of the detection of manufacturing errors or the absence of counselling or incorrect counselling as dispensing errors. From a quality assurance point of view, it is important to redress this paucity of data. A US study showed that an intensive counselling intervention significantly improved care-giver accuracy and adherence in administrating liquid medications to children [27].

There is little information about the underlying causes of dispensing errors, because most studies have not addressed this. In the few root-cause analyses that have been performed, the most important causes of dispensing errors were related to organizational problems, such as shortages of staff and high workloads, which are clearly related. The same causes of dispensing errors were mentioned in a survey of pharmacists [18].

Conclusion

Over the years pharmacists have implemented various methods to reduce the rates of dispensing errors. We found only a few studies that measured the impact of such methods. Understandably, the interventions were mostly specific to the local settings. There are several pharmacy distribution systems, and different pharmacies have different processes for distributing medications; it is not clear to what extent the results of these studies were location specific. Consequently, further research in other settings is necessary.

Although the rates of dispensing errors are low, further improvements in pharmacy distribution systems are still important. From the perspective of pharmacy organization and quality assurance, pharmacists should also intensify checking of prescriptions in order to reduce prescription errors, and should implement strategies to communicate adequately with patients in order to prevent administration errors. More and better studies are still needed in these areas.

More research is also required on: dispensing errors in outpatient healthcare, such as community pharmacies in the USA and Europe; dispensing errors in hospitals and outpatient healthcare in middle- and low-income countries; and the underlying causes of dispensing errors.

Competing interests

None to declare.

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